

Gibson County Coal Mine

Princeton, Indiana, USA

Ground freezing is often specified for sinking production mine shafts through deep, water-bearing ground. The technique was first used at a US mine in 1888.



The project

Expansion of Gibson County Coal's operations to access additional coal reserves included the sinking of the North Portal No. 2 ventilation shaft, a vertical service shaft 32 ft in excavated diameter and terminating approximately 550 ft below ground surface. However, more than 100 ft of saturated soils, mostly composed of sands lying within the flood plain of the Patoka River, overlie competent coal-bearing rock at a depth of 115 ft. The mine owner specified ground freezing to stabilize the overburden soils during shaft excavation and liner placement.

The challenge

Piezometer readings taken over a pre-freeze, 40-day period revealed abrupt changes in water levels within the sand aquifer, corresponding to water level fluctuations in the Patoka River, half a mile away. To protect the project from seasonal flooding, the owner specified the construction of a raised work platform and collar to prevent inundation of the shaft during a flood.

The solution

Keller's ground freezing design called for approximately 40, 4-inch diameter, steel closed-end freeze pipes, plus a comprehensive array of piezometers and temperature monitors, installed through the overburden soils and extending 15 ft into the underlying sound rock. The pipes were installed from the work platform twelve feet above the original ground surface. The prime supply and return pipelines were located in a gallery built around the shaft collar, and safely above the natural ground surface, which was in fact inundated for a brief period during the formation of the frozen wall. Each individual freeze pipe was surveyed to verify the verticality and distance from the adjacent pipe to ensure design criteria were achieved. Closure was accomplished approximately 8 weeks after the initiation of ground freezing. Subsequent excavation through the overburden soils was problem-free.

Project facts

Owner(s)

Gibson County Coal Company

Keller business unit(s)

Keller

Main contractor(s)

Frontier-Kemper

Solutions

Groundwater control and dewatering

Markets

Mining

Techniques

Ground freezing

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